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A PREDICTIVE SCREENING TEST FOR CHILDREN WITH ARTICULATORY SPEECH DEFECTS.

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THE CONSTRUCTION OF A TEST TO IDENTIFY DEFECTIVE ARTICULATION IN FIRST-GRADE CHILDREN WAS REPORTED. THE 'EMPIRICAL SCALE DERIVATION METHOD' WAS SELECTED AS THE MOST APPROPRIATE TECHNIQUE TO SEEK TEST ITEMS FOR THE PREDICTION OF ARTICULATORY MATUARATION. AFTER SELECTION AND REDUCTION TO 135 TEST ITEMS, AN EXPERIMENTAL ITEM POOL WAS ADMINISTERED TO 167 BEGINNING FIRST-GRADE CHILDREN. THESE SUBJECTS HAD BEEN DIAGNOSED TO HAVE FUNCTIONALLY DEFECTIVE ARTICULATION. REQUESTS WERE MADE THAT NONE OF THE SUBJECTS RECEIVE THERAPY DURING THE STUDY PERIOD. THE SUBJECTS WERE CLASSIFIED IN THE BEGINNING OF THE SECOND GRADE AS HAVING STILL DEFECTIVE OR NORMAL ARTICULATION. THIS WAS DONE ALSO AT THE THIRD-GRADE LEVEL WITH THOSE SUBJECTS STILL AVAILABLE. ITEM ANALYSES WERE PERFORMED TO IDENTIFY ITEMS WHICH DIFFERENTIATED THE GROUPS. A RESPONSE RECORD SHEET WAS INDIVIDUALLY SCORED WITH THE KEYS DERIVED EMPIRICALLY. THE RESULTANT FREQUENCY DISTRIBUTIONS OF SCORES WERE ANALYZED AND POSSIBLE CUT-OFF SCORES ESTABLISHED. (RS)

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Charles Van Riper

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WESTERN MICHIGAN UNIVERSITY

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1966

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INTRODUCTION

Background of the Problem

The child's acquisition of the standard speech sounds has long been known to take place over a period of time, and the length of time required for this learning or maturation varies with different individuals. Some children develop mature articulation as early as four years, others not until age eight or later, and a smaller percentage never master their speech sounds completely until they receive intensive speech therapy. Various surveys report different prevalence figures, but most of them indicate that approximately five per cent of the school population misarticulate one or more of the speech sounds.

A large proportion of these children are enrolled in the primary grades. One study of a sample of 757 public school speech therapists showed that 75% of the children enrolled in their caseloads were in the kindergarten or the first or second grades and that 81% of these children possessed defective speech sounds (13). Many public school speech therapists carry caseloads of from 75-100 children who typically receive speech therapy twice a week, usually in small groups. These excessive caseloads and the scheduling problems they create make it very difficult to do effective therapy, especially with the more severely handicapped children who may require more intensive or individual therapy.

Public school speech therapists often become discouraged when faced by such caseloads and the lack of adequate opportunity to help those who need them most. This can be especially frustrating in view of the possibility that some of the children receiving therapy may not actually need any special help. Numerous researches, to be summarized later, have shown that many primary grade elementary school children with articulatory defects seem to "outgrow" or master their difficulties without therapy. Unfortunately, at the present time, we have no efficient and reliable way of distinguishing these children from those who will persist in their sound errors.

One way of solving the problem thus presented would be to devise a prognostic test which could identify, in a population of children with defective sounds, those children who can be expected to master correct sound production without speech therapy. A number of potential advantages in such a test are readily apparent. If the children who will master their speech sounds by themselves could be eliminated from therapy, more therapy time would be available for the severely handicapped children requiring individual and clinical help. Clinical contacts with parents and classroom teachers might also be facilitated if the time available for these consultations could thus be increased. Dependable early identification of children who will require therapy would help to ensure that they begin to receive intensive help before their articulatory errors are strongly habituated. The duration of therapy required in these cases might, at least theoretically, thereby be reduced. Such a test might even represent one step toward the alleviation of the continuing shortage of public school speech therapists. Since the public school therapist also could have greater opportunity to do more effective professional work, perhaps the unity would be enhanced within a profession which shows signs of schism between clinical therapists and those in the public schools. The public school setting could become more attractive to therapists who, in turn, would seek graduate training in order to gain increased competence in coping with the more difficult cases which would remain after predictive testing. It is possible, then, that a valid and reliable prognostic test--in addition to vastly improving the public school speech therapy services afforded individual children--would have far reaching implications for the entire speech and hearing profession.

Purpose of the Project

The specific purpose of the present project was to construct an effective and efficient test with which to identify those first grade children with defective articulation who can be expected to master normal speech without speech therapy.

Related Literature

The maturation of articulation. A voluminous literature attests to the gradualness of the acquisition of normal speech. The research of Irwin and his co-workers demonstrates that the beginning of an orderly progression in sound acquisition, characterized by a shift from front to back vowels, can be observed even in the first year of life (4). The syllabic and phonetic structure of the early words of infants show a similar progression in the acquisition of the consonants, the earliest ones being predominately the labials and post-dentals with the other consonants appearing later (3). Metraus (7) studied the utterances of children at seven pre-school age levels from 18 to 54 months and demonstrated a progressive mastery of the correct articulation of both vowels and consonants with time. The research of Templin (20) and Poole (12) and many other workers shows clearly that speech sound mastery is a gradual process in child development.

This delay has been variously viewed as a result of physiological maturation or of temporal factors in the learning process and most usually as the result of both. Myelinization of the higher cortical nerve tracts is not completed until the second or third months of life. The first vocal utterances are purely reflexive. The development of normal speech depends upon the normal growth of the structures used in speech. Not until puberty is the organism ready to produce the adult voice. The acquisition of the entire repertoire of standard speech sounds demands much in terms of muscular coordination as well as phonetic discrimination, and these are dependent upon physiological maturation as well as upon learning. Experiments such as that by Strayer (19), in which one twin was given intensive language training while the co-twin was not, indicate that physiological maturation is quite as important as learning.

The process of speech development apparently is still occuring in a substantial proportion of children in the primary grades. Incidence studies of students in primary schools without speech therapy services show a progressive decline in the number of children possessing articulation errors. The surveys reported in the White House Conference Report (22), Mills and Streit (10), Roe and Milisen (14) and Loutitt and Halls (5) all show a marked decrease in the percentages of children with articulatory speech defects from grade one through three, and this decrease is paralleled by a similar decrease in errors per child. As Milisen summarizes, "Apparently, articulation is likely to improve until the age of 9 or 10; but after that age, for the most part, misarticulated sounds remain defective unless therapy is provided." (9, p. 253) Public school speech therapists, as we have seen, have the bulk of their caseloads in the first three grades, and the great majority of their cases are the children with articulation errors. If a suitable instrument could be devised which would identify those children whose errors will disappear with maturation, much therapy time could be saved.

It is also possible that the administration of speech therapy to some of these children may fixate their errors and prevent the normal processes of self correction from occurring. This possibility has been discussed by Van Riper (23) who asks the following questions: "Does public school therapy with its emphasis upon competition and games tend to create an impression of permanent failure in speech sound acquisition? Does it provide too much concentration on the error sounds? Does it make these children so error conscious that the errors become fixed?" He also reports that a survey of public school speech therapists revealed that "on the average only about 40% of the caseload is dismissed by the end of the second year of therapy." This figure, as the surveys have shown, fairly closely approximates the percentage of children overcoming their articulation errors without therapy. Again, the urgent necessity for a prognostic instrument is apparent.

Predictors of articulatory mastery. Other investigators have attempted to devise prognostic tests. Snow and Milisen (16) elicited marked improvement in the articulation of some children by brief stimulation with isolated standard sounds and speculated that a "more carefully designed oral and visual stimulation test..." might have prognostic value. In a study concerned with the predicting changes in the articulation of kindergarten children, Farquhar (2) reported that the child's ability to imitate the examiner's correct production of the child's misarticulated speech sounds appeared related to subsequent improvement. Carter and Buck (1) found children who were able to correct 75% of their errors on a picture naming test when they used these same sounds in nonsense syllables, and the authors suggested that such children should be excluded from speech therapy until the end of the second grade. Steer and Drexler (18) found that the total number of articulation errors, the position of the error within the word, and the type of error were all indices of some value in predicting the later articulation skills of kindergarten children. As pointed out by Nichols (11), however, the time and validity problems inherent in the techniques suggested by Steer and Drexler and by Carter and Buck severely limit the usefulness of these procedures to the practicing therapist.

Rose (15) surveyed schools having no speech therapy services and administered articulation tests to children referred as having sound errors.

Rechecking the same children at the end of one year, he found that children with more than two errors showed little improvement while children with two errors or less had improved greatly, except when the errors concerned the R sound or were lateral lisps. The frequently reported inconsistency of misarticulations among young children has been interpreted by Spriestersbach and Curtis (17) as a factor possibly related to the process of articulatory maturation; and inconsistency is felt by Templin and Darley (21) to be an important variable in determining prognoses for children in therapy. MacDonald (6), too, suggests that the number of contexts in which a defective sound is used correctly might be used as a prognostic index. Van Riper and Irwin (24, Ch.3) have observed that consistency of error, speech of repeated response, and type of error--in terms of its degree of approximation to the standard sound--should all be weighed in making a therapy prognosis. That progression in articulatory mastery is characterized by different types of errors and that the type of error has prognostic significance are views supported also by Milisen (8).

It is clear that the mastery of the standard speech sounds is a gradual and relatively lawful process, that certain children who are found to have articulatory errors in the early elementary grades seem to be able to overcome them without speech therapy, and that a prognostic test of articulatory mastery might be feasible and certainly would be desirable.

PROCEDURES

Method of Test Construction

The method of empirical scale derivation was believed to provide the most appropriate techniques with which to seek test items for the prediction of articulatory maturation. Empirical scale derivation, often employed in psychological test construction, involves the keying of an item pool in terms of some criterion external to the instrument itself. The pool, in the present case, was an extensive list of items which tested skills presumed to be related in some degree to the acquisition of mature articulation. The external criterion variable was defined as successful mastery of normal articulation within a specified period of time. This criterion variable was used to dichotomize a large group of children, all of whom had shown defective articulation when the items originally were administered to them. Contrasts between the item responses of these two sub-groups then provided the basis for selection of those differentiating items which, taken together, would comprise the desired predictive test. The entire project was accomplished, as described below, in a series of sequential stages.

Compilation of the Test Battery

Initial Item Pool. A beginning pool of 500 possible test items was procured in the following fashion. The literature was scanned to identify all test results or behaviors or statements of opinion about characteristics which might have prognostic value. Among the items thus elicited were tests of intelligence, motor ability, hearing acuity, perceptual factors, developmental growth, and emotional stability. In addition, thirty experienced public school speech therapists were interviewed concerning their own opinions concerning indicators of favorable prognosis in therapy. Finally, a group of 20 second grade children who had corrected their articulatory errors without speech therapy and another group of twenty who had not were examined and their parents and teachers were interviewed. The resulting pool or universe contained, of course, many items which could not possibly be used; but at this stage it was advantageous to procure as large a sampling as possible.

First Revision of Item Pool. Since the projected screening test was one which would have to be administered by busy therapists in the public school setting, certain criteria were set up to insure its administrability. (1) The final test battery should be able to be administered within five to ten minutes; (2) the directions should be simple and clear enough so that no special training would be required for its administration; (3) the behaviors tested should be those appropriate to the age level of a child in the first grade; (4) the scoring of each item should require only a pass-fail judgment; (5) the items selected should be those with high retest reliability and ones which different therapists would score in the same way; (6) the items should, if possible, require no props or materials not readily available to any public school speech therapist.

Accordingly, the original pool of items was subjected to scrutiny in terms of these criteria by six therapists with the result that 300 were eliminated. Among the eliminated items were some which required the child to perform motor activities in which the coordinations and/or time patternings appeared too complex for the average first grader. Other items were felt to require a longer memory span or a more mature interest level than might reasonably be expected at this age level. A few items were ruled out because of the difficulty in phrasing instructions for them in a manner which would be readily and uniformly interpretable by examiners. Some items, on the basis of this closer inspection, appeared to require a greater degree of qualitative judgment than was considered desirable in the development of any standardized scoring procedure. The factor most often responsible for the deletion of an item, however, was that of time; individually these items simply consumed too much time in their administration to warrant inclusion in the battery. In the case of each eliminated item, all six of the participating therapists were required to agree that the item be removed from further consideration. The 200 items which remained were considered to possess sufficient face validity and sufficient ease of administration for the pilot testing.

The Experimental Item Pool. A group of 60 subjects then were tested in the following manner. Six public school speech therapists administered the pilot test form of 200 items to each of ten first grade children diagnosed by them as having articulatory speech defects of sufficient severity to enroll them in their caseloads. These speech therapists were asked to evaluate each item in terms of the adequacy of its directions and ease of administration. The six therapists then, after a lapse of three to four weeks, each retested five of the children that had been originally tested by another therapist. Chi squares were computed for each of the items retested, and again when tested by different examiners. On the basis of these procedures, 65 items were eliminated because their test-retest reliability was too low or because the therapists objected to the items as being too difficult or time consuming in administration.

Of the remaining 135 items, 111 items were direct tests of some behavior in the child--items to which a child's response might relatively easily be classified either as passing or failing. The other 24 items of the Experimental Item Pool were retained primarily for their possible value in supplementing and/or synthesizing results obtained with the basic 111 items. These 24 items, among other things, required the examiner to record information about such factors as: the child's speaking rate; his cooperativeness in the testing situation; his voice quality; his number of siblings; subjective impressions of the child's intelligence; and certain compilations and summations of responses observed in the other 111 items. Thus, while a total item pool of 135 items (See Experimental Item Pool, Appendix A) was finally employed, only 111 items actually were regarded potentially as directly utilizable in an objective, reliable and efficient predictive test.

Administration of the Experimental Item Pool

The entire Experimental Item Pool was administered, by a single examiner, to 167 beginning first grade children within a two-month period during the fall of 1962. These children were drawn from public school systems in the southwestern Michigan vicinity. The time required for testing each child ranged from 7 to 12 minutes, with the average time approximating 8 minutes. An individual response record sheet was used in collecting the required data on each child.

Subjects. Each of the 167 first grade subjects was judged by a state certified public school speech therapist to have articulation sufficiently defective to warrant enrollment in a state reimbursed therapy program, served as subjects. There were 95 boys and 72 girls in this initial group. No child was included whose articulatory deviation appeared relatable to any anatomic anomaly, or who was enrolled in any form of special education classroom. No child was included, either, who was known to have a clinically significant hearing loss--although no test of hearing was administered as part of the present project. In order to permit their inclusion in this study, it was arranged that none of these children would receive speech therapy services during the ensuing two years.

Examiner. The administration of the Experimental Item Pool was accomplished, in the case of each subject, by an experienced speech therapist who was employed especially for this project and who was trained specifically in the administration of these test items.

Assessment of Articulation Skills in Second and Third Grades

During a two-month period in the fall of 1963, when the subjects of this study were beginning the second grade, each available child (22 subjects had moved or were otherwise inaccessible) was rechecked by the trained project examiner by means of a simple phonetic inventory and by the elicitation of samples of spontaneous connected speech. On the basis of these observations each subject was classified as a member either of the "Still Defective Group" or of the "Normal Articulation Group". Similarly, in the fall of 1964 those subjects still available at the third grade level (an additional 11 subjects were lost in this interval) were again re-examined and reclassified in the manner described above.

Treatment of the Data

Item Analyses. On the bases of the second and third grade dichotomizations ("still defective" versus "normal" articulation), individual item analyses were performed over each of those 111 items in the Experimental Item Pool which, as discussed above, appeared potentially most amenable to inclusion in the type of test desired. In this manner items were identified which differentiated: (1) between first graders with defective articulation who subsequently had acquired normal articulation within one year and those who had not; and (2) between first graders with defective articulation who subsequently had acquired normal articulation within two years and those who had not. In both instances the relative frequencies of "passing" responses to each test item were determined for the Still Defective Group and for the Normal Articulation Group. Selection of differentiating items was based upon the rejection of the null hypothesis that the proportions within the two groups were equal. The *t* statistic was employed in these analyses, and the nulll hypothesis was rejected when the computed *t* reached or exceeded the value required for statistical significance at the five per cent level of confidence ($t_{.05} = 1.96$).[1]

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[1]

$$t = \frac{p_n - p_d}{SE_{diff}}$$

where $SE_{diff} = \sqrt{p_c q_c \ (1/n_n + 1/n_d)}$

and p_c = the proportion of passing responses in the two subgroups combined

$q_c = 1 - p_c$

n_n = number of subjects in the Normal Articulation Group

n_d = number of subjects in the Still Defective Group

Scoring Individual Test Results. Of the statistically significant differentiating items identified by the procedure outlined above, those which also met other a posteriori criteria for acceptability (to be discussed further in the Results section of this report) comprised experimental forms of the Predictive Screening Test of Articulation. With both the First Experimental Form (based on the second grade dichotomization) and the Second Experimental Form (based on the third grade dichotomization), the following scoring procedures were employed.

An item weight of one was assigned to the passing response for each of the items which were found to differentiate between the Normal Articulation Group and the Still Defective Group. The response record sheet of each subject was then scored individually with this scoring key. Omitted responses and failing responses were assigned weights of zero. Each subject's score, then, represented a simple arithmetic summation of the number of accepted differentiating items to which he made a passing response.

Score distributions. Frequency distributions of scores on the two experimental forms of the Predictive Screening Test of Articulation (PSTA) were analyzed, and comparisons were made between appropriate sub-groups in terms especially of the possible establishment of effective and efficient cut-off scores.

Cross-Validation of the Predictive Screening Test of Articulation (PSTA)

First Experimental Form. In the original proposal of this project it had been anticipated that a cross-validation of this first form would be completed during the designated duration of Project No. 1538. Accordingly, in the fall of 1964 the First Experimental Form of the PSTA was administered to 120 first graders with defective articulation. These subjects were drawn from the states of Montana, Nebraska and New York, where the children were tested by cooperating speech therapists in the respective states.

The administrative problems associated with the conduct of a cross-validation study on this basis obviously introduced foreseeable limitations, especially with respect to insuring follow-up on the subjects. In particular, the participating therapists could not all be counted upon to remain available in a specified school district for the re-assessment of subjects' articulation skills in the subsequent year or years. Also, it usually was necessary to communicate arrangements for this testing through intermediary persons (e.g., a state speech and hearing consultant) rather than to the participating therapist directly. For these reasons it was deemed advisable also to seek additional new subjects for cross-validation purposes in the Kalamazoo, Michigan, area where better control of these variables would be possible. Arrangements were made to proceed accordingly.

At this point, however, before any local cross-validation could begin, an interesting trend was discerened in the articulatory status of the initial population of subjects--the children who then were being re-examined as they began the third grade. An unexpected but marked increment had occurred in the number of children who became error-free during the second grade. It earlier had been observed that the number of subjects who evidenced normal articulation at the beginning of second grade was quite small; hence, there was reason to expect that the empirically derived scale represented in the First Experimental Form of the PSTA might lack stability. Furthermore, there was no reason to assume that this form necessarily included any indices of those factors which might be related specifically to articulatory maturation which had occurred in the second grade. In view of the possibility that a second form of the PSTA would prove far more stable--and because the purpose of the project would best be served by recognizing the spontaneous articulatory improvement which unquestionably was continuing through the second grade--the formal cross-validation of the First Experimental Form was pursued no further. No Kalamazoo area subjects were tested, in order that resources for such subjects would remain readily available for use with the Second Experimental Form.

It subsequently proved impractical, if not impossible, to obtain adequate re-evaluation data on the Montana, Nebraska and New York subjects. These participating therapists, however, had provided insightful comments regarding the test instructions and the administration and scoring techniques employed in the early form. Their reactions led to modifications later incorporated in the format of the Second Experimental Form of the PSTA; so, the "pilot cross-validation study" was not without value to the project as a whole. The problems raised by these therapists who had no direct access to the investigator, and who had no special training in administering the test, suggested bases for procedural changes which should make any final form of the PSTA a more generally useful instrument.

Second Experimental Form of the PTSA. In this final phase of the project, the Second Experimental Form of the PSTA has been administered to a new population of 293 first graders in the Battle Creek and Bay City, Michigan areas. The articulation of these children will be re-examined in the second grade this fall and again a year from that time upon entrance into third grade in order to insure the validity of the instrument.

A proposal for a small supplementary grant to conclude this cross-validation in eighteen months has been submitted to the U.S. Commissioner of Education. It remains to be demonstrated that the PSTA will perform as effectively and efficiently with a new and independent sampling of first grade children as it has with the population from whose initial responses the final test items were derived. Analyses of the resultant cross-validation data, if the effectiveness of the test is corroborated, will permit the establishment of reliable cut-off scores for its use in screening. While it is highly desirable that the PSTA be made available to practicing speech therapists as soon as possible, the test cannot be released for other than experimental purposes until this cross-validation has been accomplished.

RESULTS

The relative frequencies of "passing" responses to each of the 111 basic test items of the Experimental Item Pool are presented in Appendix B for the Normal Articulation Group and for the Still Defective Group at both the second and third grade levels. Omitted responses occurred very infrequently and were not considered in the keying of items selected for either form of the Predictive Screening Test of Articulation (PSTA).

First Experimental Form of the PSTA

All available subjects of the initial population were retested by the project examiner, in the fall of 1963, to identify those who had spontaneously overcome their speech disorders without speech therapy. Of the initial 167 first grade subjects, 145 were still available for this retesting at the beginning of the second grade. The results of this speech evaluation revealed that 37 (25 per cent) of the subjects no longer presented any articulation problem at the end of this one year interval. To insure that this group of subjects was free of misarticulations, local speech therapists also were asked to examine each child using their own diagnostic methods. None of the 37 children were judged by these therapists to have an articulation defect. An item analysis subsequently was conducted with the total group dichotmoized into a Normal Articulation Group of 37 subjects and a Still Defective Group of 108 subjects.

Of the basic 111 items in the Experimental Item Pool, 51 differentiated the Normal Articulation Group from the Still Defective Group, yielding _t_ values as great or greater than that required for statistical significance at the five per cent level of confidence. In the case of all but two of the significant items (Item 97 and Item 98), the Normal Articulation Group had made "Passing" responses with greater relative frequency than had the Still Defective Group. Both of the exceptions to this trend were items which required that the subject, in order to "pass", be able to identify correctly the examiner's imitation of one of the child's own error sounds. The Normal Articulation Group failed these two items more frequently than did the Still Defective Group.

Each subject's score, representing a simple summation of the number of significant items to which he made a "passing" response (or "failing" response, in the case of the two items cited above), was then computed. The cumulative frequency distributions of scores in each of the two groups of subjects are shown in Table 1.

The range of scores in the Normal Articulation Group was from 23 to 48, with a median score of 41. Within the Still Defective Group the range was from 6 to 47, with a median score of 27. The overlapping between the two groups is marked, but it should be noted that 20 per cent of the Still Defective Group obtained scores lower than did any member of the Normal Articulation Group. It also is relevant that 76 per cent of the Normal Articulation Group obtained scores of 34 or greater, while 75 per cent of the Still Defective Group obtained scores of 33 or lower.

Because of the nature of the requirements in some of the significant items (e.g., subjectivity of the judgment required, dependency of an item upon the results of administering a related item, and the use of pictured stimuli or other props), the effect of eliminating certain items was explored in the following manner. The individual response sheets were rescored, omitting these items: 1, 2, 3 and 5 (these items require the use of pictures to elicit the desired responses); 60 (this item involves the use of cereal and requires a judgment about the child's swallowing pattern which may not always be easy to observe); 91 (this item is highly similar to item 92 and seemed unnecessarily repetitive, especially in view of the fact that only a small proportion of the subjects failed either item); 97, 98, 99, 101 and 101 (these items, which involve the child's

Table 1. Cumulative frequency (cf) and cumulative relative frequency (crf) distributions of scores obtained on a scale composed of 51 items which differentiated second grade children who continued to have defective articulation and second grade children who had attained normal articulation

	Second Grade Still Defective Group (n = 108)		Second Grade Normal Articulation Group (n = 37)	
Score	cf	crf	cf	crf
48			37	1.00
47	108	1.00	35	.95
46	107	.99	34	.92
45	107	.99	31	.84
44	107	.99	26	.70
43	107	.99	22	.60
42	106	.98	20	.54
41	101	.94	19	.51
40	98	.91	15	.40
39	93	.86	15	.40
38	92	.85	15	.40
37	90	.83	14	.38
36	90	.83	13	.35
35	87	.81	10	.27
34	87	.81	9	.24
33	81	.75	9	.24
32	78	.72	9	.24
31	76	.70	8	.22
30	75	.69	6	.16
29	69	.64	5	.13
28	64	.59	3	.08
27	57	.53	3	.08
26	46	.43	3	.08
25	40	.37	2	.05
24	32	.30	1	.03
23	28	.26	1	.03
22	22	.20	0	.00
21	20	.18		
20	17	.16		
19	16	.15		
18	13	.12		
17	11	.10		
16	11	.10		
15	10	.09		
14	10	.09		
13	8	.07		
12	6	.06		
11	6	.06		
10	3	.03		
9	3	.03		
8	2	.02		
7	1	.01		
6	1	.01		
5	0	.00		

response to stimulation on error sounds, are dependent upon the child's responses to earlier items in the inventory--thereby introducing reduced standardization of the testing procedure from child to child).

If a test which included only the 40 remaining items could be shown to be satisfactorily discriminative, it was felt that it would be more efficient and that the uniform administration procedure would be desirable.

The cumulative frequency and cumulative relative frequency distributions of scores on the selected 40-item test in each of the two groups of subjects are shown in Table 2. The scores in the Normal Articulation Group here ranged from 18 to 40, with a median score of 34. In the Still Defective Group the range was from 4 to 38, with a median score of 23. The separation between the median scores, then, was nearly as great on the 40-item test as it had been on the 51-item test. In the Still Defective Group 19 per cent of the subjects obtained lower scores than did any member of the Normal Articulation Group. In the Normal Articulation Group only one subject received a score of less than 20, while 34 subjects (31 per cent) in the Still Defective Group received scores of less than 20. In addition, 70 per cent of the Normal Articulation Group scored 27 or higher and 70 per cent of the Still Defective Group scored 26 or lower. On the basis of these data only the selected 40 items were retained as the First Experimental Form of the Predictive Screening Test of Articulation (Appendix C).

If a score of 26 (as a possible criterion of acceptability for a therapy caseload) were established as a cut-off score in this form of the PSTA, it may be seen that approximately the same margin of possible misplacement would occur in both groups. The margin of error, moreover, is sufficiently low to suggest that this tentative cut-off score would satisfactorily differentiate the two groups of subjects represented in this phase of the project. The error obviously is an improvement over that which would arise if all first graders with articulatio

Table 2. Cumulative frequency (cf) and cumulative relative frequency (crf) distributions of scores obtained on the First Experimental Form of the PSTA by children who continued to have defective articulation at the second grade level and by children who had normal articulation at the second grade level.

	Second Grade Still Defective Group (n = 108)		Second Grade Normal Articulation Group (n = 37)	
Score	cf	crf	cf	crf
40			37	1.00
39			36	.97
38	108	1.00	34	.92
37	106	.98	29	.78
36	106	.98	27	.73
35	104	.96	24	.65
34	100	.93	19	.51
33	98	.91	15	.40
32	94	.87	14	.38
31	92	.85	14	.38
30	90	.83	14	.38
29	86	.80	13	.35
28	82	.76	13	.35
27	79	.73	11	.30
26	76	.70	10	.27
25	74	.68	9	.24
24	69	.64	4	.11
23	65	.60	3	.08
22	53	.49	3	.08
21	44	.41	3	.08
20	37	.34	2	.05
19	34	.31	1	.03
18	26	.24	1	.03
17	21	.19	0	.00
16	17	.16		
15	15	.14		
14	12	.11		
13	11	.10		
12	10	.09		
11	10	.09		
10	10	.09		
9	8	.07		
8	7	.06		
7	5	.05		
6	4	.04		
5	3	.03		
4	1	.01		
3	0	.00		

defects were either included in therapy or excluded from it. In view of considerations reviewed elsewhere in this report (pp. 13-14), however, no attempt has been made to cross-validate the apparent effectiveness of any cut-off score on the First Experimental Form of the PSTA.

Subsequent administrations of the PSTA First Experimental Form, in the format in which it appears in Appendix C, revealed that the mean time required for the administration and scoring was 4.67 minutes. Thus, at least with the initial population of subjects, this form of the PSTA appeared economical with respect to administration time and potentially effective as a differentiating test instrument.

Second Experimental Form of the PSTA

Of the 167 subjects who in 1962 comprised the initial population for this study, 134 were available for articulatory re-evaluations by the project examiner in the fall of 1964. At the first grade level in this final group of 134 subjects the number of consonant sounds misarticulated, of 23 consonants then tested, had ranged from one to 19 with a mean of 5.23. It was found in 1964 that 63, or 47 per cent, of these subjects no longer had articulation defects at the beginning of the third grade--a relatively great increment over the 25 per cent who, at the beginning of the second grade, had been found to have normal articulation one year after the initial testing. Only one subject was observed to have defective articulation at the third grade level who had been evaluated as free of error at the second grade level.

The subject population was again dichotomized into a Normal Articulation Group (n = 63) and a Still Defective Group (n = 71), and an item analysis was completed. Of the 111 items being considered, 57 differentiated these two groups at or beyond the five per cent level of confidence. In 41 of these 57 items the difference between groups was statistically significant at or beyond the one per cent level of confidence. Forty-one of the 57 items were items which also had differentiated the Normal Articulation Group from the Still Defective Group at the second grade level. The items requiring the child to recognize an imitation of his own error, incidentally, did not differentiate the groups at the third grade level; but Item 97 still showed the tendency for more frequent failure in this type of task among the Normal Articulation Group members than among the other subjects.

On the basis of considerations similar to those employed in delimiting the First Experimental Form of the PSTA, the following significant items were eliminated from further tabulations: 2, 3, 4, 5, 6, 10, 91, 99, 101 and 103. The remaining 47 items, which constitute the Second Experimental Form of the PSTA, in the Experimental Item Pool, and the number in parentheses is the number assigned to that item in the Second Experimental Form of the PSTA as it appears in Appendix D.

13 (5)
14 (6)
15 (7)
16 (8)
17 (9)
18 (10)
20 (11)
22 (1)
23 (2)
24 (3)
26 (4)
34 (39)
35 (40)
38 (41)
40 (42)
42 (43)
43 (44)
51 (46)
53 (47)
61 (12)
65 (13)
66 (14)
67 (15)
68 (16)
69 (17)
70 (18)
71 (19)
72 (20)
73 (21)
74 (22)
75 (23)
76 (24)
77 (25)
78 (26)
79 (27)
80 (28)
81 (29)
82 (30)
83 (31)
84 (37)
85 (32)
86 (33)
87 (34)
88 (35)
89 (36)
90 (38)
92 (45)

The individual response record sheet of each subject then was scored on the 47-item test, and Table 3 presents the cumulative frequency and cumulative relative frequency distributions of these scores in each of the two groups of subjects.

Table 3. Cumulative frequency (cf) and cumulative relative frequency (crf) distributions of scores obtained on the Second Experimental Form of the PSTA by children who continued to have defective articulation at the third grade level and by children who had normal articulation at the third grade level.

	Third Grade Still Defective Group (n = 71)		Third Grade Normal Articulation Group (n = 63)	
Score	**cf**	**crf**	**cf**	**crf**
47			63	1.00
46			62	.98
45			58	.92
44	71	1.00	54	.86
43	70	.99	49	.78
42	70	.99	47	.75
41	70	.99	41	.65
40	70	.99	31	.49
39	70	.99	29	.46
38	69	.97	26	.41
37	68	.96	26	.41
36	66	.93	25	.40
35	64	.90	24	.38
34	60	.84	22	.35
33	58	.81	22	.35
32	57	.80	20	.32
31	56	.79	16	.25
30	54	.76	9	.14
29	44	.62	7	.11
28	41	.58	5	.08
27	36	.51	4	.06
26	33	.46	3	.05
25	30	.42	2	.03
24	29	.41	2	.03
23	26	.37	22	.03
22	23	.32	2	.03
21	19	.27	2	.03
20	17	.24	2	.03
19	15	.21	2	.03
18	13	.18	0	.00
17	11	.16		
16	9	.13		
15	8	.11		
14	8	.11		
13	7	.10		
12	7	.10		
11	6	.08		
10	4	.06		
9	4	.06		
8	4	.06		
7	3	.04		
6	1	.01		
5	1	.01		
4	0	.00		

The range of scores in the Normal Articulation Group was from 19 to 47, with a median score of 41. The range of scores in the Still Defective Group was from 5 to 44, and the median score in this group was 27. This separation of medians is of the same magnitude as the separation observed with the 51-item scale derived at the second grade level, and it is slightly greater than the separation observed on the First Experimental Form of the PSTA. Only four subjects (six per cent) of the Normal Articulation Group received scores as low as, or lower than, the median score in the Still Defective Group; and only one subject in the Still Defective Group received a score as high as, or higher than, the median score of the Normal Articulation Group. Moreover, 18 per cent of the Still Defective Group received scores lower than the lowest score obtained by any member of the Normal Articulation Group. In spite of the overlap between these two score distributions, then, the 47-item test appears to differentiate quite effectively between the two groups.

In terms of possible cut-off scores, of course, any decision must be based on _a priori_ assumptions regarding the relative seriousness of the two types of error which necessarily arise at any cut-off level. If, for example, one wishes to maximize the probability of identifying for therapy those children who will not have normal articulation by the third grade, a very high cut-off score might be dictated. In the extreme case of this type, it might be specified that all children who receive scores of 44 or less should be included in therapy. This then would include all members of the Still Defective Group in the present population; unfortunately, it also would include 85 per cent of the members of the present Normal Articulation Group. If, on the other hand, only children who receive scores of 18 or less were included in therapy, no members of the Normal Articulation Group in the present population would be given therapy. Nearly one-fifth of the Still Defective Group, however also would be excluded from therapy.

It is difficult to imagine a situation in which either of these extremes in case selection might be appropriate. Even the use of such cut-off scores, nevertheless, would represent a procedural improvement over the relatively common arbitrary policies either of inclusion or of exclusion of all first grade children with functionally defective articulation. In addition, the efficacy of a standardized technique for case selection is relatively simple to evaluate, while decisions based solely on cinical judgments often seem to defy similar assessment.

In our present state of professional knowledge, and in the absence of evidence to the contrary, it would seem most reasonable to select a tentative cut-off score which would yield approximately equal degrees of error in both groups. Adhering to this principle, a score of 31 would represent perhaps the most efficient cut-off level with reference to the present subject population. If, for example, only children who scored fewer than 32 points were included in speech therapy, all but 25 per cent of the Normal Articulation Group would be excluded, while all but 21 per cent of the Still Defective Group would be included. We must remember too that speech therapy services still can be offered to those few individuals who fail to overcome their errors by the end of the second grade. Therapy is merely postponed.

Reliability of the Second Experimental Form of the PSTA. A product-moment correlation coefficient of .81 was obtained between the scores of 293 first-grade cross-validation subjects on two randomly selected halves of this 47-item test. The reliability coefficient, as estimated by means of the Spearman-Brown formula, is .895. Thus, the criteria both of administrative time economy and reliability appear to have been satisfied.

Cross-Validation of the Test. It remains to be demonstrated, of course, that the PSTA will predict the spontaneous acquisition of normal articulation accurately in a new and independent population of first grade children. As yet there are no data of this type available. It is interesting to note, however, that in one of our cross-validation populations (113 children in the Bay City, Michigan, area) the median score among first grade children with articulation defects is 30. In another (180 children in Battle Creek, Michigan), the median is 33. The test also has been administered to 68 first graders in Plainwell, Michigan, and the median score in that group is 31. If it is true that approximately 50 per cent of first graders with articulatory defects score above our tentatively suggested cut-off score of 31, and if it also is true that approximately 50 per cent of first graders with this problem do indeed attain normal articulation skills without speech therapy, then these preliminary observations are impressively consistent with the observations which might be anticipated if the PSTA were assumed to be a valid tool. If those children who scored above the median prove to be, in large measure, the same children who demonstrate normal articulation when they are re-checked at the third grade level, then the validity of the PSTA will have been demonstrated.

SUMMARY AND DISCUSSION

Summary

This study involved an attempt to compile a battery of short test items which could be administered swiftly to first grade children with articulation errors in order to predict which children will eliminate their errors without professional speech therapy.

In the fall of 1962, 167 first grade children with defective articulation were administered a large pool of test items which had been accumulated for their possible prognostic value. In the fall of 1963, the articulation of each child still available was re-checked, and the group was then dichotomized on the basis of normal versus still-defective articulation. An item analysis was performed, and 40 of those 51 items which significantly differentiated between the two groups were compiled as the First Experimental Form of the Predictive Screening Test of Articulation.

No formal cross-validation of this first form was pursued for two basic reasons: a) the number of children who had gained normal articulation by the second grade was small (n=37) and it was assumed that the empirically derived scale might therefore lack stability; and b) more importantly, in the fall of 1964 a marked increment was discerned in the number of children, now beginning third grade, who displayed normal articulation. It was evident that a scale based on the new dichotomy, in addition to being potentially more stable, ultimately would be of far greater interest and utility to the therapist. A "pilot" cross-validation begun with the First Experimental Form permitted the exploration of problems which might be encountered with new examiners and different children. The results of this "pilot" cross-validation led to several format and procedural changes which were incorporated in the more recent test form.

Following the item analysis which was performed on the third grade dichotomization of subjects, we were able to compile the Second Experimental Form of the Predictive Screening Test of Articulation. This form, which contains all of the statistically significant differentiating items except those few which involved special administration problems, was administered in September and October, 1965, to 293 first grade children in nearby school systems. Each of these children was diagnosed as having a functional articulation problem, and none of the children will receive speech therapy until they have been re-checked in the fall of 1967. Investigation of the effectiveness of the PSTA in an independent population constitutes the final phase of this project.

Discussion

The main task of the project, the construction of a short, easily administered battery of test items which differentiate groups of first grade children who do and who do not eliminate their articulation errors after one or two years, seems to have been achieved for the population tested. Although the cross-validation phase of this study is still in progress, a number of observations and tentative conclusions appear relevant.

First of all, it is apparent that many first and second grade children with articulatory defects are able to overcome their errors without professional speech therapy. Of the first grade children with such defects at the beginning of the project, 25 per cent were shown to have become error free one year later; 47 per cent had become error free two years later at the beginning of the third grade. Since, as our review of the literature has demonstrated, a large proportion of the caseloads of public school speech therapists are enrolled in these grades, it is quite possible that much therapy time is devoted to children who would master their speech problems by themselves. Since the present test, at least in its final experimental form, appears able to identify these children with reasonable accuracy, it seems tenable that the use of this instrument could reduce the caseloads to permit more intensive or individual therapy with those children who need it most. At the same time, certain dangers should be noted. If, due to arbitrary administrative policies, rigid caseload and scheduling requirements are continued, then the public school speech therapist will be faced with the necessity for attempting to treat relatively larger numbers of severely handicapped children in the same length of time that formerly was devoted to caseloads of which almost half were children who probably would have mastered their errors anyway. It is conceivable, too, that some administrators would welcome such a predictive screening test as a solution for their annual problems in recruiting therapists. If approximately half of the caseloads of their speech therapists were "eliminated" by the PSTA, they might feel that they would only need half as many therapists. Should such an eventuality occur, its effects upon therapist success and morale and the opportunity to do more intensive professional work would probably be catastrophic. If our cross-validation of the test proves its usefulness, every therapist who uses it in the public school setting should be cognizant of these possible consequences.

Another interesting finding during the test construction and revision was that, of all the items considered, the most effective predictors of self mastery of articulation errors appear to be those that tested articulation skills themselves. In our original batteries of test items we had many that dealt with motor ability, structural features of the articulators, and perceptual factors such as phonetic discrimination, auditory memory span, phonemic synthesis and analysis. A few of these were eliminated because of time or difficulty in administration, but many of them that remained did not show significant differences between the two groups. Of the 67 items that showed significant differences at one or the other grade level only eight items could be classified under these categories; and in the Second Experimental Form of the PSTA only two, clapping a rhythmic pattern with the hands and recognizing an error on the vowel r, were retained. We can only account for this finding by hypothesizing that speech production itself is probably the end result of the interplay of many of these factors and that any one of them by itself can play but a minor part in group differences. Another possibility is that motor and perceptual factors cannot be assessed by observation of such short segments of behavior. The relatively great number of items which did not differentiate between the groups tends, too, to emphasize that the groups were essentially similar in many respects and that the speech therapist must constantly seek greater refinement in the tools and techniques he employs for the diagnosis of functional articulation problems.

At any rate, it appears that the best predictors of articulation mastery are to be found in the speech itself. This should not be too surprising if articulation errors are viewed as part of the developmental process. Van Riper and Irwin (24, Ch. 4) have described the process of phonemic acquisition in terms of progressive approximation. The original non-standard utterances pass through a shaping process, with each successive approximation coming closer to the standard sound. Error elimination, as seen by these and other authors, is not ordinarily a sudden substitution of a correct for a formerly incorrect sound but a progression of minor revisions in the direction of that sound. The PSTA may perhaps be seen as identifying some of the key sounds and words that represent the terminal stages of the approximation process. We regret that the exigencies of the test format with its pass-fail scoring system did not permit a phonetic analysis of the actual errors shown, for we feel that predictive cues might well have been found in this material too. We hope that future research will investigate these phenomena.

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APPENDIX A

The Experimental Item Pool

Items 1 through 10

Instructions. "I'm going to show you some pictures. You tell me what it is that you see. What's this one?" (underlined portion indicates the sound or sounds being tested)

1. Bird
2. rabbit
3. soap
4. leaf
5. thumb
6. zipper
7. fish
8. chair
9. feather
10. cup

Scoring. Mark space 1 on IBM sheet for successful utterance of sound.
Mark space 2 if the sound is omitted.
Mark space 3 if the sound is distorted.
Mark space 4 if another sound is substituted for this sound.

Item 11

Instructions. "Let's see if you can put your first finger sidewise between your teeth like this and click your tongue like this." Finger should be held sideways so the incisors touch the beginning of the end segment. Tongue click should be done at a rate of about two per second. Give three trials if necessary before scoring as failure.

Scoring. Score as success if any trial results in any clear tongue click. Ignore rhythm or timing failure. Sucking clicks should be scored as failures, as should refusals. Place mark in space 1 on IBM sheet for success; in column 2 for failure.

Item 12

Instructions. "Now let's see if you can put your thumb between your teeth like this and click your tongue." Examiner demonstrates placing thumb between incissors and at a right angle to their surface. Same rate as above for demonstration.

Scoring. The same as in item 11.

Items 13 through 20

Instructions. "NOw let's see if you can say some words after me. I'll say each word only once, so listen carefully. Here's the first word . . . ."

13. music
14. valentine
15. teeth
16. smooth
17. arrow
18. bathtub
19. there
20. sheep

Scoring. The same as has been outlined for items 1 - 10.

Items 21 through 30

The purpose of this test is to see the results of stimulation in producing possible improvement in articulation. These are the same words used in items 1 - 10.

Instructions. "Remember those pictures I showed you a little while ago? I'm going to tell you how to say those words this time. I'll say each word clearly three times. Then you say it back to me. Listen carefully to how I say them." (If child says word before you have said it three times, stop and caution him not to do so, but be sure to give only three stimulations.)

21. bird
22. rabbit
23. soap
24. leaf
25. thumb
26. zipper
27. fish
28. chair
29. feather
30. cup

Scoring. The same as for items 1 - 10

Item 31

Instructions. "Let's see if you can whistle? Whistle like this . . . ." Examiner whistles twice (about 1 second in duration each).

Scoring. Score as a success only if a clear whistle is heard and if it is produced on exhalation. Inhalation whistles and breath alone are to be scored as failures. Ignore number or timing. If any clear whistle is heard, it should be scored in column 1 ad a success. Score failures in column 2.

Items 32 and 33

Instructions. "Now I want to see if you can catch me when I say a word wrongly. Listen: "Monday, Tuesday, Wednesday, Fursday, Friday . . . ." Which word did I say wrong? It was Thursday. I said FFFursday, didn't I?" Say words at rate of 1 per second. Be sure to say the error word without undue emphasis. "Now let's try some other words, Try to catch me when I make a mistake."

32. "One...two...free...four...five...." What word did I say wrongly?"

Scoring. If child signals the word or says it correctly or incorrectly, enter it in column 1 as a success. If he picks out two of them, insist that he make a choice. If he doesn't know or refuses, enter in column 2 as a failure.

33. "OK. Here are some more words. On which one did I make a mistake? Nose......fingers.......face......mouf......"

Scoring. As in item 32.

Item 34

Instructions. "Now let's see if you can say a whole sentence after me. Say all of this: 'The radio fell down.' Good! Now say this sentence: 'This radio looks like it's busted!" (Except for coughing or extraneous noise, do not repeat it.)

Scoring. All we're interested in here is the number of words remembered and misarticulated. Score in column 1 for complete sentence spoken without error. Mark column 2 of one or two words were misarticulated; column 3 if three words were wrong or missing; column 4 if four words were in error or missing; column 5 if five or more words were missing or in error. Ignore multiple errors within a single word. Thus, if the child says, "This radio yook like it's busted" only one word would be counted as wrong and thus you would mark in the bracket in column 2.

Items 35 through 38

Instructions. "Say these sounds after me...." (Examiner prolongs each sound for a silent count of three seconds, and makes it strongly and clearly.)

35. s 36. l 37. ʒ 38. θ

Scoring. Mark as success if the sound is produced correctly by child and mark column 1. Ignore duration. If complete or partial failure occurs (distortion or substitution) or if child refuses, mark in column 2.

Items 39 through 43

Instructions. "Now let's say some other sounds...." Examiner says each of the nonsense syllables three times, thus: leeleelee, but not leeleelee, leeleelee, leeleelee. Make the three syllables continuous in utterance, without gaps between syllables.

39. leeleelee
40. seeseesee
41. theetheethee
42. zuzuzu
43. puhtuhkuh

Scoring. Mark column 1 if child repeats any one of the three nonsense syllables correctly even though others may be in error. Thus wee-lee-lee would be considered a success. We just want to know if the child can ever make the sound correctly in a nonsense syllable. One exception to this rule occurs in item 43. In this one, all three syllables puh-tuh-kuh must be said correctly to be scored as a success. Puh-tuh-tuh would be called a failure. Score failures in second column.

Item 44

Instructions. "Now I'm going to hum a little song: mmmmm $^{\text{mmmmm}}$ mmmmm like this. Let me hear you do it too. Here we go . . . ." Examiner hums it again, using the scale notes of do-mi-do. Examiner may repeat the stimulation so the child can be sure of what is desired.

Scoring. Score success in column 1 if child is successful in singing or humming the proper intervals. Disregard sounds used, but the intervals must be correct; and only three notes should be used. Ignore inexactitude of durations of notes. Score failures or refusals in column 2.

Item 45

Instructions. "Now let's sing another little song like this: mi $_{\text{do}}$ mi."

Scoring. Same as item 44.

Items 46 through 48

Instructions. "Let's see if you can say some numbers after me. Wait till

I say all of them.... Here we go! One....seven...." "Examiner says these numbers about one second apart. Give the example using two other numbers if the child does not seem to understand or refuses.) "Wait till I raise my hand before starting to say them. Wait till I say all of them...."

46. "All right. Now I'll say three numbers. Wait till I raise my hand and then tell me what they are.....3.....9.....5....."

47. "Good. Now I'll give you four other numbers. Wait till I raise my hand and then tell me what they are.....8.....5.....1.....6....."

48. "Now let's see if you can say an Indian word after me. It's how Indians talk. I'll say it twice, then raise my hand. Then you say it. The Indian word is "Buggabee. ....Buggabee." (Raises hand.) If child fails to understand , use some other combination of three nonsense syllables for illustration of what is desired. "O.K. Now here's another Indian word: Bohdanohpah...Bohdanohpah...." (Raise hand.)

Scoring. The series of digits or nonsense words must be repeated exactly to be scored as a success in column 1. Any error or refusal is scored in column 2 as a failure.

Item 49

Instructions. "Click your teeth like this...." Examiner clicks teeth together three times, showing child her teeth as she does so. Repeat stimulation if necessary.

Scoring. Score as success in column 1 if child bites regularly even if the number of clicks is more or less than three. Score failure in column 2 if biting is irregular in rhythm or no clicking is heard or if child refuses.

Item 50

Instructions. "Here's a salted peanut. I'm going to put it under my tongue right here and then I'm going to chew it. Like this." (Examiner places peanut under her own tongue in the midline, then scoops it out with her tongue and chews and swallows it.) "Now I'm going to give you a peanut but I've got to put it under your tongue in the same place. Chew it up as fast as you can."

Scoring. Score success in column 1 if child can start chewing peanut in two seconds. Score as failure in column 2 if child takes more than two seconds or must use fingers or eject it first. Score as failure any refusal.

Items 51 through 52

Instructions. "I want to find out if you know when I say a word right or know when I say it wrong. You know what this is....(Examiner points to own nose) ...Ok., now this hand says that it's my NOTH and this hand says that it's my NOSE. Which hand said it wrong?" (Repeat again using words mouth and mouse, or other pairs until child understands.)

51. "Here's another chance to catch me. Is this my finguh (E. looks at right hand) or is it my finger (E. looks at left hand.) Which one did I say wrong? Point to it."

52. "All right. Now let's try another. Try to show me which one I say wrong.... Do I bounce a ball (Examiner acts out bouncing imaginary ball with right hand) or do I bounce a bah? (Examiner acts out bouncing ball with left hand) Point to the one I said wrong."

Scoring. Score as success by marking in column 1 if child identifies correct hand. Insist that he pick out a hand. If he says the word correctly, ask him to point to the hand that said it that way. Score failures in column 2 for wrong identification or for refusal.

Item 53

Instructions. "Now let's see if you can clap your hands just like I do...." Examiner demonstrates by clapping this rhythm: clap...Clap...Clap, Clap,Clap. (First three claps are separated in time by intervals of about one second. Intervals between last three claps are about one-half as long.)

Scoring. Score success in column 1 if rhythm is accurate; failure in column 2 if not, or if there are extra or insufficient clappings.

Item 54

Instructions. "Let's see if you can do what I do." (Demonstrates biting lower lip, then protruding lips and saying oo. Examiner demonstrates sequence twice.) "Do it twice. Do it just like I do."

Scoring. Score success in column 1 if child does both activities in proper sequence twice. Score failure in column 2 if he only does it once, or if he fails to get both activities in proper order, or if he does only one of them. This is basically a test of imitation. Give only one demonstration.

Item 55

Instructions. "Can you sing this note? Don't begin until I raise my finger...." (Examiner sings oo for two seconds at about middle C and raises her finger after about the first second of the note's duration. If child fails to attempt the note, repeat stimulation.)

Scoring. Score success in column 1 if child is able to match the pitch or its octave. If he begins off key but finds it, score this as a success too. Score as failure any production which does not match the pitch.

Item 56

Instructions. "I'm going to sing you a little song that I bet you know - Happy Birthday to You - Help me sing it." (Examiner sings first two phrases of song. Repeat it so child can sing it in unison with you.) "Now let's see if you can sing it alone. O.K. Let's go....I'll start you out...." (Examiner sings "Happy birthday" .....and lets the child finish alone.)

Scoring. Score as success in column 1 if melody is true. Ignore differences in key. Ignore minor failures to hit notes exactly. Score as failure in column 2 if melody is unrecognizable except in words and rhythm, and also if more than three notes are off pitch.

Item 57

Instructions. "Let's see if you can stick out your tongue and curl it up like this..." (Examiner demonstrates.) "Stick it way out..." Give three trials if necessary.

Scoring. Score as success if tongue is protruded and the tip is lifted. (Column 1) Score as failure if tongue merely licks upper lip without definite protrusion or if obvious difficulty in lifting tip is demonstrated. If the child obviously used large jaw and lip movements to assist tongue in lifting, score as failure. Also, if tip makes a minimal lifting movement.

Item 58

Instructions. "Now move your tongue from side to side like this..." (Examiner demonstrates. Make movements at a rate of about one per second. Give three demonstrations if necessary.)

Scoring. Score as success in column 1 if child successfully alternates lateral movements of tongue without sluggishness or having to make repeated attempts to get the tongue over to one side. Score as failure in column 2 if tongue has obvious difficulty in going over to one side, if the movements are sluggish and facial or jaw movements are used to assist.

Item 59

Instructions. "Now let's make this funny sound. Like a motorboat...." (Examiner trills tongue for about two seconds. (Give three trials if necessary.)

Scoring. Score as success in column 1 if definite trill is heard, no matter how short the duration. Score as failure in column 2 if no trill is heard or if child refuses.

Item 60

Instructions. "Here's a little piece of sugar coated cereal that I'm going to give you. I want you first to pretend I've already given it to you. Pretend it's in your mouth and swallow it...O.K. Here's another pretend piece... And here's the real thing... (Examiner gives child the cereal. If necessary, continue this routine until the child's swallow pattern has been revealed.)

Scoring: The thing we're after here is to determine whether or not the infantile swallow has persisted. Score as success if normal swallow is demonstrated. (Column 1) Score as failure if these behavior occur: (Column 2)

a. tongue protrudes between teeth. (Part lips with your fingers if necessary to see if this is occurring.)
b. the facial muscles are contracted and marked protrusion and pursing of the lips is present.

Items 60 through 90

Instructions. All these items are to be administered in the same way as those of items 13 through 20. Only one presentation of the stimulus word is given except when the child fails to hear it due to coughing or other masking noise.

61. dishes
62. television
63. yellow
64. onion
65. chair
66. matches
67. watch
68. jar
69. engine
70. presents
71. bread
72. crayons
73. grass
74. frog
75. three
76. clown
77. flower
78. smoke
79. snake
80. spider
81. stairs
82. sky
83. sweeping
84. splash
85. plant
86. shredded wheat
87. tree
88. dress
89. sled
90. string

Scoring. Same as for items 13 - 20.

Item 91

Instructions. "Now put your little finger between your teeth like this and say la-la-la..." (Examiner demonstrates, placing tip of little finger between front incissors and biting down on fingernail gently.)

Scoring. Score as success in column 1 if child does as directed. Score as failure if no la is heard, but also if la is heard but lips purse around finger. We here are interested in the tongue's ability to move independently of the associated lip movements.

Item 92

Instructions. "Now stick your thumb in your mouth like this and say la-la-la...." (Examiner demonstrates, biting on thumbnail.)

Scoring. Same as Item 91.

Item 93

Instructions. "Now lets see if you can suck with your tongue like this..." (Examiner produces several sucking clicks with tongue. If child only produces lip suck clicks as in kissing, it would be considered a failure, so restimulate and show him the difference.)

Scoring. Score as success if clear suck click is heard once. (Column 1) Score as failure if no clear tongue suck click is heard (Column 2).

Item 94

Instructions. "Now open your mouth like this and say ah. Now hold your mouth open and lift your tongue up and down like this... Keep it inside your mouth." (Examiner demonstrates) "Now hold your tongue up high inside your mouth like this...." (Examiner demonstrates.)

Scoring. Use penlight to illuminate mouth. Note bowing of tongue's anterior surface, inability to raise tongue tip, and presence of frenum attachment within one-fourth inch of tongue tip as criteria of tongue tie. Score as success in Column 1 if tongue is normal and no tongue tie exists. Score as failure in column 2 if all three criteria are fulfilled.

Items 95 and 96

Instructions. "I'm going to say some words in a funny way...awfully slowly. You must try to guess what I'm saying. Here' one, for example: mmm....ow....th. Now I'll say it a little faster. What am I saying? mmm...ow..th; mm.ow.th; mouth. See, I've been saying mouth,mm..ow..th, all the time." (Examiner should make sure child understands. If confused, do the same thing on the word "face" until child gets the idea. Try no more than two other demonstration examples.

95. "O.K. Now let's see if you can guess what this word is: Sh...oe.." (Examiner prolongs each sound one second and the gap is also one second.)

96. "Now let's try another. What word am I saying now: nnn...o...zzz."

Scoring. Score success in column 1 and failure in column 2. Score refusal or inability to understand as failure. If child guesses the word No prematurely in item 96, begin over again and say that he should wait until you are through. If he still says No, score as a failure.

Items 97 and 98

Instructions. "Now I'm going to see if you can catch me making a mistake in saying a word wrongly. I'm going to say some words and one of them I'll say wrong. You tell me what it is... Listen: baby, fingoh, shirt. Which word was wrong? It was finger, wasn't it. I said fingoh, not finger. Fingoh is the wrong one."

97. Examiner selects first error word misarticulated by the child in the test and combines it with two other words which he has said correctly, in this order: 1. Normal word; 2. Error word; 3. Normal word. Examiner imitates child's error on the error word. "Which of these words am I saying wrongly? ______(normal word);______ (error word); ______(normal word)."

98. Examiner selects second of the error words the child misarticulated and combines it with two normally spoken words but in this sequence: error word; normal word; normal word. "Try to catch me this time... (error, normal, normal)"

Scoring. Score as success, the child's identification of the misarticulated word (Column 1). Score as failure his selection of some other word, refusal, or failure to understand.

Items 99 through 104

Instructions. "I noticed that sometimes you don't say some of your sounds right and make some mistakes. I think you didn't say ________ right. I think you said ________." (Examiner inserts correct sound, nonsense syllable, or word in the first of these spaces, and the child's error in the second of these spaces.) "Now here's the way to say it right...(Examiner demonstrates correct form, repeating it three times) "Now you say it right...."

99. Stimulate child in the above manner with a sound in isolation. This should be the first sound which the child misarticulated in the test.

100. Same as item 99, using the second error sound.

101. Stimulate the child in the above manner with the first error sound, using it in the medial position of a nonsense syllable (VCV).
102. Same as item 101, using second error sound.

103.. Stimulate the child in the above manner with the first error sound, using it in the actual word which was misarticulated in the test.

104. Same as item 103, using second error word.

Scoring. Score any one success in column 1; score consistent failure in column 2.

Item 105

Instructions. "I'm going to make a funny sound with my lips. Then you make it...(Examiner flutters lips without voice three times for a duration of about one breath each.)

Scoring. Score as a success in column 1 any true flutter no matter how brief. Score as failure in column 2 any refusal, incorrect performance or the mere blowing out of breath through pursed lips.

Items 106 and 107

Instructions. Examiner shows child a picture containing a bat, ring, fan and foot. "See. Here's a picture. See the things in it? There's a bat. There's a ring. (points to each object as it is named) There's a fan. There's a foot.... Now I want you to tell me which of those words rhymes with can. Which word sounds most like it? Is it bat? Or ring? Or fan? Or foot? Which sounds like or rhymes with can? It's fan. Hear it... can sound like fan; fan-can....."

106.. "Now here's another picture and I want you to point to the thing whose name sounds most like HAT. Is it can or cat or horse or boat? Which one sounds most like HAT?

107. "Here's another picture. I wonder if you can find the word that sounds like SUN. Is it gun or saw or bone or cup?

Scoring. Score success for selection of correct word (in column 1). Score refusal and selection of incorrect word as failure in column 2.

Item 108

Instructions. Examiner shows picture used in Item 107. "Now I'm going to say all but one of the names of these things wrong and I want you to correct me. I'll just say one of them right. Correct me on only the wrong words. Make sure I said it wrong before you correct me. That's a dun...; That's a thaw...; That's a boh... That's a cup. (If child has trouble understanding what is required, explain again, and then use the pictures in Item 106, pronouncing only the last word correctly.)

Scoring. Score as success only if child does not correct the last word. We want to know if he can recognize correct words. Ignore quality of correction on other words. Score as failure if he attempted, correctly or incorrectly, to say the last word again, indicating that it also was in error.

Items 109 and 110

Instructions. "NOw here are some other pictures, but we're going to do something different this time. I want to know if you know which sound starts the word." (Examiner shows child illustration plate)"
"See, here's a rake. Rake starts with rrrrr. Hear it? rrrake."
"And here's a shoe. Shoe starts with SH...... Hear it? Shoe." (prolong the sh)
"And here's a moon. Moon starts with mmmmm. Hear it? mmmoon."
"And here's a kite. Kite starts with (k)" (Examiner whispers the k)
"Now let's see if you can tell me which of these starts with sh? Point to it."
(If child is successful, show picture in item 109. If not, explain what is desired again, selecting some other sound.)

109. "O.K. Here's another picture. There's a chair (pointing); There's a watch; There's some matches. Which one of these starts with ch?"

110. "Here's another picture. Here's a gun. Here's a car. Here's a balloon. Which one of these starts with k (Examiner whispers k).

Scoring. Score success in column 1 if child picks out or says correct word. Ignore any articulation error. Score as failure if he does not comprehend or selects wrong word, or refuses to try.

Item 111

Instructions. "Let's try just one more thing. See if you can make this sound...." (Examiner produces bilabial buzz with flattened lips. Make it three times of one second each.)

Scoring. Score as success any close approximation. Score as failure in column 2 any production of oo or lack of voice or refusal.

Items 112 through 121

In these items, the examiner will have to use his own judgment based upon his experience as a speech therapist. All estimates should be fairly liberally interpreted. We are primarily interested in the more extreme deviations from the normal. The examiner will have to get some samples of the child's spontaneous speech and this can be done while asking about the other children in the family, where the child lives, parent's occupation and the like. The examiner should also interview the teacher concerning the child's social maturity and adjustment in school (Item 118) or get this information by a questionnaire note.

112. Is the rate of the child's spontaneous speech normal? Or fast?

113. Is the child's speech readily intelligible? Or difficult to understand?

114. Is the child normally fluent? Or unusually hesitant?

115. Are the quality, pitch and intensity of the child's voice normal for his age? Or abnormal?

116. Would the examiner predict that this child will be free of articulatory errors in two years?

117. What is the examiner's estimate of this child's intelligence: superior, average, inferior?

118. What is the classroom teacher's estimate of the child's social maturity: superior, average, inferior?

119. How cooperative was the child in the examination procedure: superior, average, inferior?

120. Is the child an only child (yes or no)?

121. Was the child clean and well dressed (yes or no)?

Items 122 through 135

These items should be answered by examination of the child's test record and they can be done later. Testing time should not be used for this purpose.

122. Number of sounds consistently misarticulated: 1, 2, 3, 4, 5 or more.

123. Are the error sounds better in the blends than as singles? (yes or no)

124. Would this child, in your opinion, respond quickly to speech therapy? (yes or no)

125. Most frequent error type: omission; distortion; substitution?

126. Were there any vowel errors? (yes or no)

127. Which of the following were observed: lalling; lateral lisp; frontal lips; nasal lisp; defective r?

128. Did child ever correct his own misarticulated utterance? (yes or no)

129. Which sounds seemed most difficult: sibilants; L or R; TH; K or G; blends?

130. Number of different sounds produced incorrectly: 1, 2, 3, 4, 5 or more?

131. Of items 1 - 5, how many were said correctly in items 21 - 25? None, k, 2, 3, 4, or 5?

132. Of items 6 - 10, how many were siad correctly in items 26 - 30? None, 1, 2, 3, 4, or 5?

133. How many different error sounds did the child have? 1, 2, 3, 4, 5 or more?

134. **How many of them were produced after stimulation in isolation? None, 1, 2?**

135. **How many of them were produced after stimulation in nonsense syllables? None, 1, 2?.**

APPENDIX B

Relative Frequency of Passing Responses for Each of 111 Items of the Experimental Item Pool and Computed t-Statistics Based upon Comparisons of Subjects with Normal Articulation and Subjects with Still Defective Articulation at Two Grade Levels

	Second Grade Dichotomy			Third Grade Dichotomy		
Item Number	Normal Articulation Group (n=37)	Still Defective Group (n=108)	t*	Normal Articulation Group (n=63)	Still Defective Group (n=71)	t*
1	.84	.67	1.99	.79	.66	1.70
2	.89	.67	2.65	.84	.59	3.18
3	.68	.47	2.20	.65	.44	2.48
4	.95	.87	1.32	.95	.82	2.41
5	.79	.57	2.40	.71	.55	1.97
6	.58	.45	1.38	.60	.38	2.58
7	.95	.94	.08	.98	.92	1.78
8	.76	.73	.41	.81	.69	1.58
9	.82	.69	1.47	.73	.69	.51
10	1.00	.93	1.62	1.00	.89	2.75
11	.76	.75	.19	.76	.73	.39
12	.82	.77	.63	.79	.76	.46
13	.71	.51	2.10	.76	.39	4.29
14	.79	.81	-.32	.87	.72	2.20
15	.68	.48	2.20	.63	.38	2.94
16	.63	.38	2.64	.52	.34	2.17
17	.89	.73	2.09	.86	.70	2.11
18	.76	.54	2.39	.67	.49	2.03
19	.92	.78	1.88	.87	.76	1.67
20	.95	.80	2.08	.90	.76	2.21
21	.84	.73	1.40	.81	.70	1.41
22	.89	.69	2.47	.84	.62	2.86
23	.79	.50	3.05	.75	.45	3.47
24	.95	.88	1.20	.98	.80	3.32
25	.87	.76	1.44	.81	.76	1.69
26	.71	.50	2.20	.73	.44	3.43
27	1.00	.90	2.06	.94	.90	.74
28	.76	.78	-.68	.86	.72	1.95
29	.84	.77	.98	.79	.75	.65
30	.97	.88	1.71	.94	.86	1.46
31	.55	.50	.51	.57	.45	1.40
32	.76	.72	.52	.78	.68	1.31
33	.74	.55	2.00	.65	.56	1.03
34	.45	.17	3.45	.41	.10	4.21
35	.79	.55	2.59	.78	.49	3.40
36	.95	.96	-.41	.98	.93	1.52
37	.89	.77	1.70	.84	.75	1.35
38	.87	.79	1.00	.87	.73	2.03
39	1.00	.93	1.62	.98	.92	1.78
40	.74	.54	2.10	.73	.49	2.80

Item Number	Second Grade Dichotomy Normal Articulation Group (n-37)	Still Defective Group (n=108)	t*	Third Grade Dichotomy Normal Articulation Group (n=63)	Still Defective Group (n=71)	t*
41	.82	.77	.63	.84	.70	1.88
42	.74	.51	2.38	.76	.42	3.98
43	.66	.53	1.34	.67	.49	2.03
44	.71	.68	.32	.73	.66	.85
45	.68	.76	-.88	.70	.76	-.81
46	.97	.93	.91	.98	.92	1.78
47	.53	.46	.72	.51	.46	.50
48	.45	.39	.59	.48	.37	1.29
49	.97	.96	.32	.97	.97	-.12
50	.95	.91	.78	.95	.89	1.37
51	.95	.87	1.32	.95	.83	2.22
52	.82	.75	.86	.76	.75	.21
53	.84	.75	1.19	.89	.66	3.11
54	.63	.69	-.68	.75	.62	1.56
55	.84	.72	1.50	.75	.73	.18
56	.58	.60	-.21	.52	.63	-1.29
57	.92	.90	.43	.89	.90	-.24
58	.95	.93	.46	.95	.90	1.12
59	.29	.21	.93	.25	.21	.58
60	.61	.38	2.37	.42	.44	-.09
61	.92	.73	2.45	.86	.68	2.45
62	.92	.70	2.72	.81	.68	1.76
63	.89	.92	-.39	.92	.80	.65
64	1.00	.96	1.21	1.00	.94	1.91
65	.82	.81	.04	.92	.73	2.84
66	.92	.82	1.46	.92	.76	2.50
67	.97	.84	2.13	.95	.79	2.77
68	.95	.91	.78	.98	.84	2.81
69	.97	.85	2.03	.95	.79	2.77
70	.95	.72	2.91	.92	.63	3.93
71	.95	.69	3.17	.86	.65	2.78
72	1.00	.71	3.74	.92	.63	3.93
73	.97	.70	3.44	.89	.65	3.27
74	.97	.64	3.93	.92	.55	4.80
75	.82	.55	2.89	.73	.52	2.49
76	.92	.78	1.98	.95	.66	4.18
77	.87	.76	1.33	.89	.65	3.27
78	.63	.36	2.85	.63	.30	3.93
79	.66	.39	2.82	.67	.31	4.13
80	.63	.38	2.64	.65	.30	4.11

	Second Grade Dichotomy			Third Grade Dichotomy		
Item Number	Normal Articulation Group (n=37)	Still Defective Group (n=108)	t*	Normal Articulation Group (n=63)	Still Defective Group (n=71)	t*
81	.66	.36	3.23	.65	.25	4.62
82	.66	.36	3.23	.65	.28	4.28
83	.66	.37	3.02	.62	.32	3.42
84	.58	.29	3.18	.57	.21	4.29
85	.95	.80	2.08	.97	.70	4.05
86	.63	.51	1.25	.71	.35	4.19
87	1.00	.80	2.95	.97	.73	3.75
88	1.00	.79	3.03	.95	.73	3.43
89	.58	.40	1.89	.62	.30	3.76
90	.63	.27	3.96	.59	.18	4.83
91	1.00	.90	2.06	.98	.86	2.63
92	1.00	.89	2.16	.98	.84	2.81
93	.95	.97	-.71	.98	.96	.90
94	1.00	.95	1.36	.98	.94	1.23
95	.37	.20	2.13	.29	.20	1.20
96	.24	.10	2.06	.19	.10	1.52
97	.71	.86	-2.06	.84	.82	.37
98	.47	.71	-2.62	.59	.70	-1.42
99	.74	.51	2.38	.65	.46	2.16
100	.45	.56	-1.20	.46	.61	-1.68
101.	.66	.35	3.34	.59	.27	3.74
102	.39	.35	.54	.40	.34	.71
103	.63	.31	3.50	.52	.30	2.69
104	.37	.42	-.56	.49	.37	1.47
105	.68	.71	-.30	.73	.68	.68
106	.71	.70	.11	.67	.70	-.47
107	.61	.62	-.13	.68	.58	1.26
108	.87	.82	.66	.87	.77	1.48
109	.61	.63	-.23	.62	.65	-.35
110	.71	.58	1.43	.59	.63	-.55
111	.66	.72	-.72	.71	.69	.30

* $t_{.05} = 1.96$

APPENDIX C

Instruction Manual and Response Record Sheet for First Experimental Form of the PSTA

GENERAL INSTRUCTIONS

The Predictive Screening Test of Articulation (PSTA) is composed of 40 items which, for convenience in administration, have been grouped into nine parts composed of from 1 to 18 items each. Instructions for administering and scoring each part of the test are given below.

Response sheets are provided for recording responses to the test items, and a separate response sheet is to be used for each child tested. Before beginning to test a child, the examiner should complete the identifying information at the top of the response sheet (except for the "Total Score", which can be obtained only after the test administration has been completed).

During the administration of the PSTA the examiner should indicate, on the response sheet, the child's response to each item. This should be done by circling the _1_ if the response was correct or by circling the _2_ if the response was incorrect. Any item to which the child gives no response should be scored as an incorrect response.

If, for any reason, the examiner is unable to hear the child's first response to an item, the child may be asked to repeat his response. The examiner may not repeat a stimulus work or sound more than the specified number of times, however, unless it is clear that extraneous noise or some other distraction obviously kept the child from hearing the initial stimulus presentation.

After all of the 40 items have been administered and scored, the examiner must count the total number of correct responses given by the child. This may be done simply by tallying the number of _1_'s which have been circled on the response sheet. The number of correct responses should then be entered in the space provided for the child's "Total Score" at the top of his response sheet.

Total time for administering and scoring the Predictive Screening Test of Articulation typically will not exceed 7 or 8 minutes.

SPECIFIC INSTRUCTIONS

After a moment or two of preliminary conversation to put the child at ease, begin formal administration of the PSTA with the items in Part I. In the directions which follow, the words which the examiner is to speak have been capitalized.

Part I. The purpose of this group of items is to determine the accuracy of the child's response to auditory stimulation words containing specified single consonant sounds.

Administration. Examiner says: "I AM GOING TO SAY SOME WORDS. I'LL SAY EACH WORD CLEARLY THREE TIMES. THEN YOU SAY IT BACK TO ME. YOU ONLY NEED TO SAY IT ONCE. LISTEN CAREFULLY TO HOW I SAY THEM." Examiner then presents Items 1 through 4, each time saying the stimulus word being tested; the words should be pronounced in a normal way. After the third presentation of a word the child is to say it.

Scoring. In brackets after each stimulus word is the phonetic symbol indicating which sound is being tested. In addition, the letter representing this sound has been underlined in the printed word. If the child articulates this sound correctly, circle 1 beside the corresponding item number on the response sheet. If the child misarticulates the indicated sound, circle the 2. Do not count the response as incorrect unless that specific sound is misarticulated, regardless of other possible errors in the child's production of the word.

Items.

1. RABBIT (r)
2. SOAP (s)
3. ZIPPER (z)
4. FISH (f)

Part II. The purpose of this group of items is to determine the accuracy with which specified single consonants are articulated in words which the child says when imitating single presentations of these words by the examiner.

Administration. Examiner says: "NOW LET'S SEE IF YOU CAN SAY SOME MORE WORDS AFTER ME. THIS TIME I'LL SAY EACH WORD ONLY ONCE, SO LISTEN CAREFULLY. HERE'S THE FIRST WORD..." Examiner then presents items 5 through 14, saying each stimulus word clearly once. The examiner is not to emphasize the sound being tested. The child is to repeat each word after the examiner.

Scoring. Score in exactly the same manner as Part I is scored.

Items.

5. MUSIC (z)
6. TEETH (θ)
7. SMOOTH (ð)
8. ARROW (r)
9. BATHTUB (θ)
10. SHEEP (ʃ)
11. DISHES (ʃ)
12. TELEVISION (ʒ)
13. WATCH (tʃ)
14. ENGINE (dʒ)

Part III. The purpose of this group of items is to determine the accuracy with which specified two- and three-consonant blends are articulated in words which the child says when imitating single presentations of these words by the examiner.

Administration. Part III is identical in administration to Part II; so there is no need at this point to give any new instructions to the child. The examiner is simply to continue with presentations of the stimulus words, saying each word clearly once. The child continues to repeat each word after the examiner.

Scoring. Each of the items 15 through 32 tests the child's articulation of a consonant blend. Except for this, the scoring is similar to Parts I and II. In brackets after each stimulus word are the phonetic symbols indicating the blend which is being tested. In addition, the letters representing this blend have been underlined in the printed word. If the child articulates the entire blend correctly, circle 1 beside the corresponding item number on the response sheet. If the child misarticulates any portion of the indicated blend, circle the 2. For example, if the child says "pwesents" for "presents" the pr blend is to be counted as incorrect. Do not count the response as incorrect, however, unless some part of the specific blend is misarticulated, regardless of other possible errors in the child's production of the word.

Items.

15. PRESENTS (pr)
16. BREAD (br)
17. CRAYONS (kr)
18. GRASS (gr)
19. FROG (fr)
20. THREE (θr)
21. CLOWN (kl)
22. SMOKE (sm)
23. SNAKE (sn)
24. SPIDER (sp)
25. STAIRS (st)
26. SKY (sk)
27. SWEEPING (sw)
28. PLANT (pl)
29. TREE (tr)
30. DRESS (dr)
31. SPLASH (spl)
32. STRING (str)

Part IV. The purpose of this item is to determine the accuracy with which all of the sounds are articulated in a sentence which the child repeats after hearing the examiner say that sentence.

Administration. This item begins with an example for the child. Examiner says: "NOW LET'S SEE IF YOU CAN SAY A WHOLE SENTENCE AFTER ME. SAY THIS: 'THE RADIO FELL DOWN'." Do not score this response. It is used only as a model to prepare the child to say the actual test sentence. After the child responds to the example, the examiner says: "GOOD, NOW SAY THIS SENTENCE..." Then the examiner says the sentence in item 33 below.

Scoring. The child's response to this item is scored with reference both to his articulation and to his ability to reproduce the entire sentence. If the child misarticulates any sound in the sentence, count his response as incorrect and circle the 2. If he omits a word from the sentence, count the response as incorrect--even if the words which he does repeat are correctly articulated. The insertion of an additional word does not make the response incorrect if the sentence is otherwise correct. In order to score a correct response, the child must repeat every word of the sentence and must articulate every sound correctly.

Item. 33. THIS RADIO LOOKS LIKE IT'S BUSTED.

Part V. The purpose of this item is to determine the child's ability to produce the (s) in isolation following auditory stimulation by the examiner.

Administration. Examiner says: "NOW I'D LIKE TO HAVE YOU SAY THIS SOUND AFTER ME..." The examiner then produces one strong and clear (s) sound, prolonging the sound for approximately three seconds. The child is then to repeat the sound.

Scoring. Circle the 1 for a correct response if the sound is produced correctly by the child. Ignore the duration of his production. If complete or partial failure occurs or if child refuses to try, count the response as incorrect.

Item. 34. Production of (s) in isolation, sustained for three seconds.

Part VI. The purpose of these items is to determine the child's ability to articulate the (s) and (z) sounds correctly in specified syllables.

Administration. Examiner says: "NOW LET'S SAY SOME OTHER SOUNDS. I WANT YOU TO SAY JUST WHAT I SAY..." Examiner then presents items 35 and 36, pausing to allow the child to respond after each presentation.

Scoring. Score the response as correct if the child repeats any one of the three nonsense syllables correctly, even though others may be misarticulated. Thus, "theeseethee" for "seeseesee" would be counted as a correct response. Score the child's response as incorrect only if all three syllables are misarticulated.

Items. 35. SEESEESEE (sisisi)
36. ZOOZOOZOO (zuzuzu)

Part VII. The purpose of this item is to determine the child's ability to move the tongue independently of the jaw and lips in producing the syllable "la".

Administration. Examiner says: "NOW PUT YOUR THUMB IN YOUR MOUTH LIKE THIS, AND SAY (examiner demonstrates, biting on thumb with upper and lower central incisors--thumbnail down) 'LA-LA-LA'."

Scoring. Score the response as incorrect if no "la" is heard. Also score the response as incorrect if the lips purse around the thumb, even if "la" is heard. Score the response as correct if "la" is produced correctly at least once of the three times and if this "la" is produced without a pursing of the lips.

Item. 37. (lalala), produced as indicated above.

Part VIII. The purpose of these items is to determine the child's ability to synthesize words from phonemes presented in isolation but in the sequence in which they appear in given words.

Administration. Examiner says: "NOW I'M GOING TO SAY SOME WORDS IN A FUNNY WAY....VERY SLOWLY. YOU TRY TO GUESS WHAT WORD I'M SAYING. HERE'S ONE, FOR EXAMPLE: MM...OW...TH (the examiner says (maʊθ), prolonging each sound briefly with an interval of approximately one second between sounds). NOW I'LL SAY IT A LITTLE FASTER: MM..OW..TH. WHAT AM I SAYING? MM..OW..TH, MMM.OW.TH, MOUTH. SEE, I'VE BEEN SAYING MOUTH ALL THE TIME." If child seems confused, examiner should give another example with the word "face" until the child gets the idea. If necessary, give one other demonstration example in a similar manner. When child understands, the examiner continues: "OK. NOW LET'S SEE IF YOU CAN GUESS WHAT WORD THIS IS..." Examiner then presents items 38 and 39, prolonging the individual sounds slightly and separating the sounds with intervals of about one second. To begin Item 39, examiner says: "NOW LET'S TRY ANOTHER..." An item should not be repeated unless extraneous noises have obviously interfered with the child;s hearing of the first presentation. An exception to this may be made on Item 39 if the child guesses the word "no" prematurely (before the examiner gives the final sound). In this event, begin the word over again and tell the child to wait until you are through. If on the second trial the child again responds with "no", his response must be scored as a failure.

Scoring. Score the response as correct if the child gives the correct word within ten seconds. The response may be scored as correct even if there is an articulation error in the response, provided that the examiner can be confident that the correct word is being said. Score the response as incorrect if the child gives the wrong word or if he cannot give any word within ten seconds.

Items. 38. SHOE (SH...OE), (ʃu) presented as indicated above.
39. NOSE (N...O...SE) (noz) present as indicated above.

Part IX. The purpose of this item is to determine the child's ability to recognize a misarticulated word among a series of words produced by the examiner.

Administration. Examiner begins by saying: "NOW I WANT TO SEE IF YOU CAN CATCH ME WHEN I SAY A WORD WRONG. LET ME SHOW YOU WHAT I MEAN. NOW LISTEN: MONDAY, TUESDAY, WEDNESDAY, FURSDAY, FRIDAY. WHICH ONE DID I SAY WRONG? IT WAS THURSDAY, WASN'T IT? I SAID FURSDAY, NOT THURSDAY. NOW LET'S TRY SOME OTHER WORDS. YOU TRY TO CATCH ME WHEN I MAKE A MISTAKE..." Examiner then presents the four word sequence in Item 40, saying the words at the rate of one per second and being sure not to emphasize the error word.

Scoring. If the child signals the error word or says it (whether correctly or incorrectly), score the response as correct. If the child picks out two words, and if one of his choices is the correct response, insist that he make a choice between the two words. If the child does not know which word was wrong, or if he refuses to respond, score his response as incorrect.

Item. 40. NOSE FINGERS FACE MOUF (mouth)

PREDICTIVE SCREENING TEST OF ARTICULATION (PSTA)
Cooperative Research Project No. 1538, Contract OE-21-089
C. Van Riper, Western Michigan University

Experimental Form
August, 1964

RESPONSE SHEET

Child's Name ________________________ Age ______ CHILD'S TOTAL SCORE ____________

Grade ____________ School ____________________ Examiner ____________________

City ________________ State ________________ Date ____________________________

Record the child's response to each item of the PSTA by circling the 1 if his response is correct or by circling the 2 if his response is incorrect (or if no response is made) Compute the child's "Total Score" by counting the number of items where 1 has been circled. Enter this score in the appropriate space at the top of the response sheet.

Item	Response	
	Correct	Incorrect
Part I		
1. RABBIT	1	2
2. SOAP	1	2
3. ZIPPER	1	2
4. FISH	1	2
Part II		
5. MUSIC	1	2
6. TEETH	1	2
7. SMOOTH	1	2
8. ARROW	1	2
9. BATHTUB	1	2
10. SHEEP	1	2
11. DISHES	1	2
12. TELEVISION	1	2
13. WATCH	1	2
14. ENGINE	1	2

Item	Response	
	Correct	Incorrect
Part III		
15. PRESENTS	1	2
16. BREAD	1	2
17. CRAYONS	1	2
18. GRASS	1	2
19. FROG	1	2
20. THREE	1	2
21. CLOWN	1	2
22. SMOKE	1	2
23. SNAKE	1	2
24. SPIDER	1	2
25. STAIRS	1	2
26. SKY	1	2
27. SWEEPING	1	2
28. PLANT	1	2
29. TREE	1	2
30. DRESS	1	2

Item	Response	
	Correct	Incorrect
31. SPLASH	1	2
32. STRING	1	2
Part IV		
33. Sentence	1	2
Part V		
34. (s)	1	2
Part VI		
35. SEESEESEE	1	2
36. ZOOZOOZOO	1	2
Part VII		
37. LA-LA-LA	1	2
Part VIII		
38. SH...OE	1	2
39. N..O..SE	1	2
Part IX		
40. "MOUF"	1	2

APPENDIX D

Instruction Manual and Response Record Sheet for Second Experimental Form of the PSTA

GENERAL INSTRUCTIONS

The Predictive Screening Test of Articulation (PSTA) is composed of 47 items which, for convenience in administration, have been grouped into nine parts composed of from 1 to 22 items each. Instructions for administering and scoring each part of the test are given below.

Response sheets are provided for recording responses to the test items, and a separate response sheet is to be used for each child tested. Before beginning to test a child, the examiner should complete the identifying information at the top of the response sheet (except for the "Total Score", which can be obtained only after the test administration has been completed)).

During the administration of the PSTA the examiner should indicate, on the response sheet, the child's response to each item. This should be done by circling the 1 if the response was correct or by circling the 2 if the response was incorrect. Any item to which the child gives no response should be scored as an incorrect response.

If, for any reason, the examiner is unable to hear the child's first response to an item, the child may be asked to repeat his response. The examiner may not repeat a stimulus word or sound more than the specified number of times, however, unless it is clear that extraneous noise or some other distraction obviously kept the child from hearing the initial stimulus presentation.

After all of the 47 items have been administered and scored, the examiner must count the total number of correct responses given by the child. This may be done simply by tallying the number of 1's which have been circled on the response sheet. The number of correct responses should then be entered in the space provided for the child's "Total Score"at the top of his response sheet.

Total time for administering and scoring the Predictive Screening Test of Articulation typically will not exceed 7 or 8 minutes.

SPECIFIC INSTRUCTIONS

After a moment or two of preliminary conversation to put the child at ease, begin formal administration of the PSTA with the items in Part I. In the directions which follow, the words which the examiner is to speak have been capitalized.

Part I. The purpose of this group of items is to determine the accuracy of the child's response to auditory stimulation with words containing specified single consonant sounds.

Administration. Examiner says: "I AM GOING TO SAY SOME WORDS. I'LL SAY EACH WORD CLEARLY THREE TIMES. THEN YOU SAY IT BACK TO ME. YOU ONLY NEED TO SAY IT ONCE. LISTEN CAREFULLY TO HOW I SAY THEM." Examiner then presents Items 1 through 4, each time saying the stimulus word three times. The examiner is not to emphasize in any way the sound being tested; the words should be pronounced in a normal way. After the third presentation of a word the child is to say it.

Scoring. In brackets after each stimulus word is the phonetic symbol indicating which sound is being tested. In addition, the letter representing this sound has been underlined in the printed word. If the child articulates this sound correctly, circle 1 beside the corresponding item number on the response sheet. If the child misarticulates the indicated sound, circle the 2. Do not count the response as incorrect unless that specific sound is misarticulated, regardless of other possible errors in the child's production of the word.

Items.
1. RABBIT (r)
2. SOAP (s)
3. ZIPPER (z)
4. LEAF (l)

Part II. The purpose of this group of items is to determine the accuracy with which specified single consonants are articulated in words which the child says when imitating single presentations of these words by the examiner.

Administration. Examiner says: "NOW LET'S SEE IF YOU CAN SAY SOME MORE WORDS AFTER ME. THIS TIME I'LL SAY EACH WORD ONLY ONCE, SO LISTEN CAREFULLY. HERE'S THE FIRST WORD..." Examiner then presents items 5 through 17, saying each stimulus word clearly once. The examiner is not to emphsize the sound being tested. The child is to repeat each word after the examiner.

Scoring. Score in exactly the same manner as Part I is scored.

Items.

5. MUSIC (z)
6. VALENTINE (v)
7. TEETH (0)
8. SMOOTH (ð)
9. ARROW (r)
10. BATHTUB (0)
11. SHEEP (ʃ)
12. DISHES (ʃ)
13. CHAIR (tʃ)
14. MATCHES (tʃ)
15. WATCH (tʃ)
16. JAR (dʒ)
17. ENGINE (dʒ)

Part III. The purpose of this group of items is to determine the accuracy with which specified two- and three-consonant blends are articulated in words which the child says when imitating single presentations of these words by the examiner.

Administration. Part III is identical in administration to Part II; so there is no need at this point to give any new instructions to the child. The examiner is simply to continue with presentations of the stimulus words, saying each word clearly once. The child continues to repeat each word after the examiner.

Scoring. Each of the items 18 through 38 tests the child's articulation of a consonant blend. Except for this, the scoring is similar to Parts I and II. In brackets after each stimulus word are the phonetic symbols indicating the blend which is being tested. In addition, the letters representing this blend have been underlined in the printed word. If the child articulates the entire blend correctly, circle 1 beside the corresponding item number on the response sheet. If the child misarticulates any portion of the indicated blend, circle the 2. For example, if the child says "pwesents" for "presents" the pr blend is to be counted as incorrect. Do not count the response as incorrect, however, unless some part of the specific blend is misarticulated, regardless of other possible errors in the child's production of the word.

Items.

18. PRESENTS (pr)
19. BREAD (br)
20. CRAYONS (kr)
21. GRASS (gr)
22. FROG (fr)
23. THREE (θr)
24. CLOWN (kl)
25. FLOWER (fl)
26. SMOKE (sm)
27. SNAKE (sn)
28. SPIDER (sp)
29. STAIRS (st)
30. SKY (sk)
31. SWEEPING (sw)
32. PLANT (pl)
33. SHREDDED WHEAT (ʃr)
34. TREE (tr)
35. DRESS (dr)
36. SLED (sl)
37. SPLASH (spl)
38. STRING (str)

Part IV. The purpose of this item is to determine the accuracy with which all of the sounds are articulated in a sentence which the child repeats after hearing the examiner say that sentence.

Administration. This item begins with an example for the child. Examiner says: "NOW LET'S SEE IF YOU CAN SAY A WHOLE SENTENCE AFTER ME. SAY THIS: 'THE RADIO FELL DOWN'." Do not score this response. It is used only as a model to prepare the child to say the actual test sentence. After the child responds to the example, the examiner says: "GOOD, NOW SAY THIS SENTENCE..." Then the examiner says the sentence in item 39 below.

Scoring. The child's response to this item is scored with reference both to his articulation and to his ability to reproduce the entire sentence. If the child misarticulates any sound in the sentence, count his response as incorrect and circle the 2. If he omits a word from the sentence, count the response as incorrect--even if the words which he does repeat are correctly articulated. The insertion of an additional word does not make the response incorrect if the sentence is otherwise correct. In order to score a correct response, the child must repeat every word of the sentence and must articulate every sound correctly.

Item. 39. THIS RADIO LOOKS LIKE IT'S BUSTED.

Part V. The purpose of these items is to determine the child's ability to produce the (s) and (θ) in isolation following auditory stimulation by the examiner.

Administration. Examiner says: "NOW I'D LIKE TO HAVE YOU SAY THIS SOUND AFTER ME..." The examiner then produces one strong and clear (s) sound, prolonging the sound for approximately three seconds. The child is then to repeat the sound. The same procedure is followed for (θ).

Scoring. Circle the 1 for a correct response if the sound is produced correctly by the child. Ignore the duration of his production. If complete or partial failure occurs or if child refuses to try, count the response as incorrect.

Items. 40. Production of (s) in isolation, sustained for three seconds.

41. Production of (θ) in isolation, sustained for three seconds.

Part VI. The purpose of these items is to determine the child's ability to articulate the (s), (z), (p), (t) and (k) sounds correctly in specified syllables.

Administration. Examiner says: "NOW LET'S SAY SOME OTHER SOUNDS. I WANT YOU TO SAY JUST WHAT I SAY..." Examiner then presents items 42, 43 and 44, pausing to allow the child to respond after each presentation.

Scoring. Score the response to 42 and 43 as correct if the child repeats any one of the three nonsense syllables correctly, even though others may be misarticulated. Thus, "theeseethee" for "seeseesee" would be counted as a correct response. Score the child's response as incorrect only if all three syllables are misarticulated. On item 44, however, all three syllables must be correctly articulated to be scored as a correct response.

Items. 42. SEESEESEE (sisisi)

43. ZOOZOOZOO (zuzuzu)

44. PUHTUHKUH (pʌtʌkʌ) - All must be correct

Part VII. The purpose of this item is to determine the child's ability to move the tongue independently of the jaw and lips in producing the syllable "la".

Administration. Examiner says: "NOW PUT YOUR THUMB IN YOUR MOUTH LIKE THIS, AND SAY (examiner demonstrates, biting on thumb with upper and lower central incisors--thumbnail down) 'LA-LA-LA'."

Scoring. Score the response as incorrect if no "la" is heard. Also score the response as incorrect if the lips purse around the thumb, even if "la" is heard. Score the response as correct if "la" is produced correctly at least once of the three times and if this "la" is produced without a pursing of the lips.

Item. 45. (lalala), produced as indicated above.

Part VIII. The purpose of this item is to determine the child's ability to discriminate between a correct and an incorrect production of (ð) and to identify the incorrect production.

Administration. Examiner begins by saying: "I WANT TO FIND OUT IF YOU KNOW WHEN I SAY A WORD RIGHT OR KNOW WHEN I SAY IT WRONG. YOU KNOW WHAT THIS IS... (Examiner points to own nose.). NOW, THIS HAND (Examiner indicates either of his own hands.) SAYS THAT IT'S MY NOTH (noð), AND THIS HAND (indicating other hand) SAYS THAT IT'S MY NOSE. WHICH

HAND SAID IT WRONG?" (Example may be repeated using words "mouth" and "mouse", or other pairs, until child understands that he is to point to the incorrect hand.) "HERE'S ANOTHER CHANCE TO CATCH ME. Is THIS (examiner indicates right hand) MY FINGUH (f́ɪŋgə), OR IS IT (examiner indicates left hand) MY FINGER? WHICH ONE DID I SAY WRONG? POINT TO IT."

Scoring. Score the response as correct if the child correctly identifies the examiner's incorrect production of the test word.

Item. 46. (fɪŋgə ... fɪŋgɚ) presented as indicated above

Part IX. The purpose of this item is to determine the child's ability to replicate a hand-clapping rhythm presented by the examiner.

Administration. Examiner says: "NOW LET'S SEE IF YOU CAN CLAP YOUR HANDS JUST LIKE I DO." Examiner then demonstrates by clapping this rhythm: clap....clap....clap..clap..clap. The first, second, and third claps are separated in time by intervals of approximately one second. The intervals between the third and fourth and the fourth and fifth claps are about one-half as long.

Scoring. Score the child's response as correct if the rhythm and number of claps are accurate. Score the response as incorrect if rhythm is not accurate or if there is either an extra or insufficient number of claps.

Item. 47. Clapping rhythm, presented as indicated above.

PREDICTIVE SCREENING TEST OF ARTICULATION (PSTA), Cooperative Research Project No.
1538, Contract OE-21-089, C. Van Riper, Western Michigan University
Second Experimental Form, August, 1965

RESPONSE SHEET

Child's Name ______________________ Birthdate __________ CHILD'S TOTAL SCORE ______

Grade ________ School ______________________ Examiner ______________________

City ______________________ State ______________________ Date ______________________

Record the child's response to each item of the PSTA by circling the 1 if his response is correct or by circling the 2 if his response is incorrect (or if no response is made). Compute the child's "Total Score" by counting the number of items where 1 has been circled. Enter this score in the appropriate space at the top of the response sheet.

Item	Response Corr.	Response Incor.
Part I		
1. RABBIT	1	2
2. SOAP	1	2
3. LEAF	1	2
4. ZIPPER	1	2
Part II		
5. MUSIC	1	2
6. VALENTINE	1	2
7. TEETH	1	2
8. SMOOTH	1	2
9. ARROW	1	2
10. BATHTUB	1	2
11. SHEEP	1	2
12. DISHES	1	2
13. CHAIR	1	2
14. MATCHES	1	2
15. WATCH	1	2
16. JAR	1	2
17. ENGINE	1	2
Part III		
18. PRESENTS	1	2
19. BREAD	1	2
20. CRAYONS	1	2
21. GRASS	1	2
22. FROG	1	2
23. THREE	1	2
24. CLOWN	1	2
25. FLOWER	1	2
26. SMOKE	1	2
27. SNAKE	1	2
28. SPIDER	1	2
29. STAIRS	1	2
30. SKY	1	2
31. SWEEPING	1	2
32. PLANT	1	2
33. SHREDDED WHEAT	1	2
34. TREE	1	2
35. DRESS	1	2
36. SLED	1	2
37. SPLASH	1	2
38. STRING	1	2
Part IV		
39. Sentence	1	2
Part V		
40. (s)	1	2
41. (θ)	1	2
Part VI		
42. SEESEESEE	1	2
43. ZOOZOOZOO	1	2
44. PUHTUHKUH	1	2
Part VII		
45. LA-LA-LA	1	2
Part VIII		
46. (ð) Recognition	1	2
Part IX		
47. Clapping rhythm	1	2